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THE GERMINATION OF BELLADONNA SEED.*

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Since commercial cultivation of belladonna has become a question of practical possibility, the methods of cultivation are receiving more and more attention. Repeated attempts at field sowing have demonstrated quite thoroughly that such methods are not successful. The tenderness and slow growth of the young plants make it a difficult matter to secure a proper stand by that method, even if the seed germinate well and seasonal conditions are favorable. Loss by insects and suffocation by weeds are the principal obstacles encountered after the plants have made their appearance. One of the main difficulties, however, lies in the fact that belladonna seed germinates very slowly and irregularly, and, as a rule, not much over 50 per cent. germinates at all.

During the course of several years many belladonna plants have been propagated by the writer in the greenhouses with very good success. With proper care and the elimination of such disturbing factors as have already been mentioned, the plants grow rapidly and uniformly. It was these experiments that afforded an opportunity of studying carefully the behavior of belladonna seed and its relative vitality. Lack of uniformity in germination and the relatively large percentage of inert seed were noted repeatedly. It was decided, therefore, to undertake some systematic examination of the seed with a view to establishing what types of seed as regards size, weight, and color, and what methods of handling are the most desirable.

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Methods of Study.

In the experiments which were conducted in the greenhouse, the seeds were planted in pots of convenient size containing good loose soil. The surface was marked off in rows about three-quarters of an inch apart, and the same number of seeds were placed in each pot for each experiment. The seeds were planted about a quarter of an inch deep, and a thin layer of sand was scattered over the surface. Suitable conditions of moisture and temperature were constantly maintained.

Effects of Freezing on the Germination.

Experience has shown that seed sown late in fall usually germinates quickly in spring, while spring-sown seed is much slower in germinating. This fact pointed to the possibility that frost might have a favorable effect in hastening germination. As a definite test a small lot of seed was divided into two parts, one to serve as a check and the other half to be frozen. The freezing was accomplished by placing the seeds in a test-tube with sufficient water to cause them to cling together, and then subjecting the tube to a temperature of —12° C. for five hours. Forty-eight seeds from this frozen lot were sown in one side of a 10-inch pot, while the same number of seeds from the untreated lot were sown in the other half as a check. These seeds were sown on April 13th. The following table gives the number and per cent. germinated at various intervals:

Table I.

Germination of Frozen and Unfrozen Seeds Sown on April 13th.

Description	Germination							
	Number				Per cent.			
	May 8	May 15	May 22	May 29	May 8	May 15	May 22	May 29
Frozen	22	24	25	26	46	50	52	54.2
Check (unfrozen)	5	10	12	13	10.4	20.8	27	29.2

Figure 1 shows graphically the percentage of total germination at each observation. The effect of freezing is immediately apparent, and the possibility suggests itself of hastening the germination of the seeds in greenhouse work by subjecting them either to cold weather or some such treatment as described above. It also empha-

sizes the value of fall sowing in case direct field sowing is resorted to. It is probable that the influence of the low temperature is largely to accelerate germination rather than to induce seeds to germinate

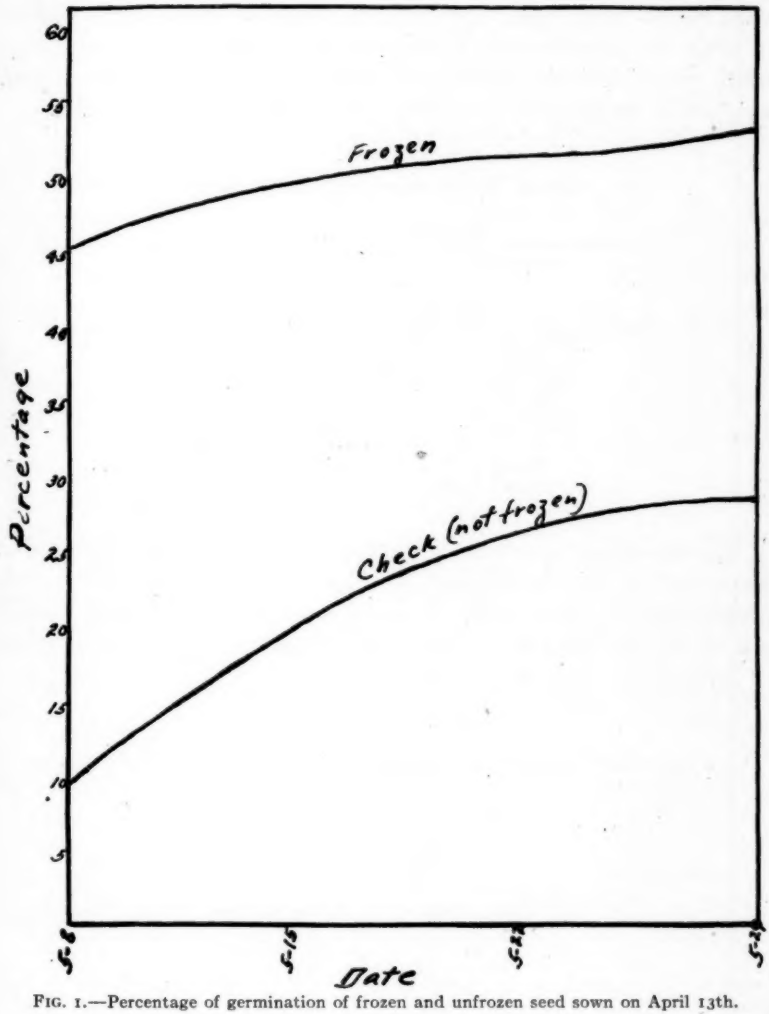

FIG. 1.—Percentage of germination of frozen and unfrozen seed sown on April 13th.

which would not otherwise do so. If this experiment had been carried sufficiently far it would very likely have been found that the check lot would eventually show a percentage of germination not much less than that of the frozen lot.

Relation of Size of the Seed to Its Germination.

Considerable variation in size exists among belladonna seed. The average seed is about one and a quarter millimetre in diameter, while the extremes range from less than one to almost two millimetres. In order to determine the relative weight of these small and large seeds, 500 of both the largest and smallest seeds were separated and weighed in portions of 100 each. Table II shows the results.

Table II.

Relative Weight of Large and Small Seeds.

Description	Weight (Gms.)	
	Large	Small
First 100.....	0.1290	0.0897
Second 100.....	0.1276	0.0820
Third 100.....	0.1324	0.0847
Fourth 100.....	0.1350	0.0825
Fifth 100.....	0.1382	0.0906
Total.....	0.6622	0.4295
Average for 100.	0.1324	0.0859

To determine the relative germination of these seeds, 300 of each were sown in two rectangular boxes on April 5th. Each box was divided into 20 rows, with 15 seeds in each row. Figure 2 shows graphically the resulting germination. Table III shows the progress of germination from time to time.

Table III.

Comparative Germination of Large and Small Seeds Sown April 5th.

Description	Germination							
	Number				Per cent.			
	May 1	May 8	May 15	May 22	May 1	May 8	May 15	May 22
Large.....	42	131	133	134	14	43.6	44.3	44.6
Small.....	43	145	150	153	14.3	48.3	50	51

From the tables and figures it is at once evident that there is practically no difference in germination due to size. In this particular case the advantage even lies with the small seeds, though the

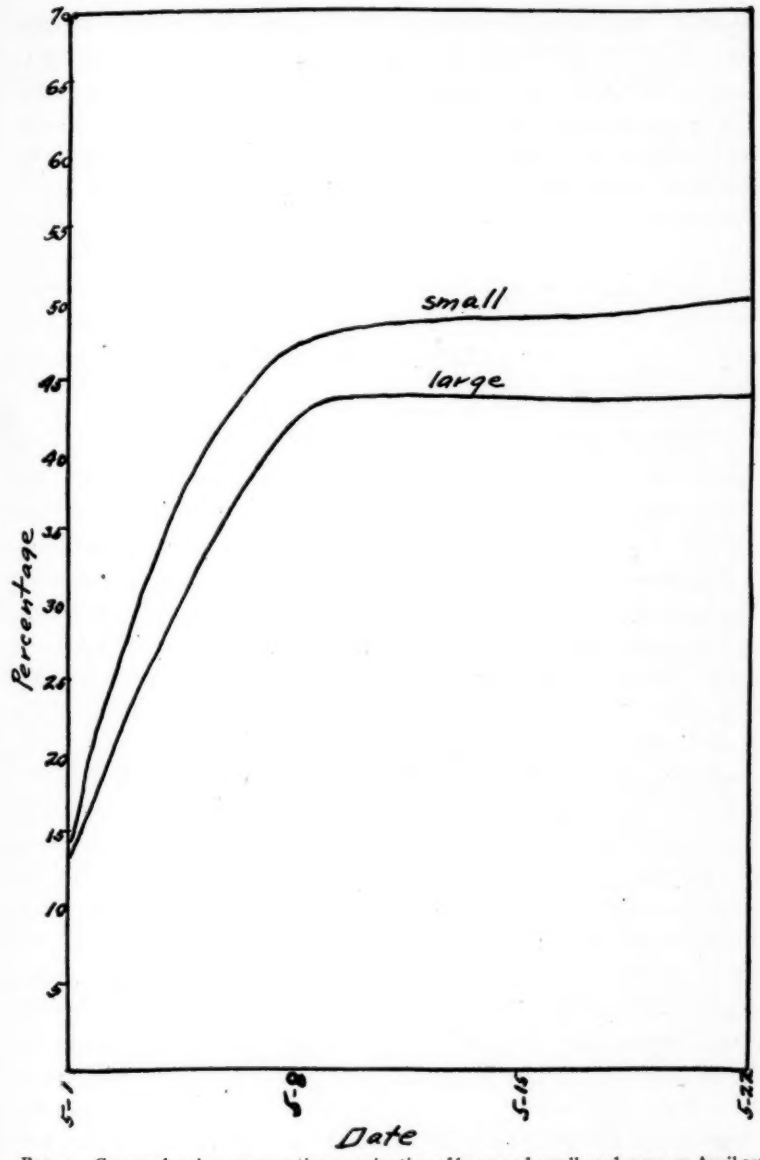

FIG. 2.—Curves showing comparative germination of large and small seed sown on April 1st.

margin is so small that it can hardly be taken to indicate that such is always the case. It appears, then, that the small seeds are in no wise inferior to the larger ones in so far, at least, as concerns the germination. What the relative growth and development of these plants will be is an entirely different problem. There was little to choose between them seven weeks after sowing. However, any inferiority due to seed would very likely not become evident until later in the plant's development. A careful study is being made of this phase of the problem with special reference to the relation of the size of the seed to the development of alkaloids in the plants grown therefrom. It is interesting to note that the progress of the germination is very similar in the two kinds of seeds, as Figure 2 plainly shows.

Relation of Weight of Seed to Germination.

While the size of the seed was found to have nothing to do with the germinating power, the question of the weight of the seed promised to be of greater importance. Like most other seeds, a considerable percentage of belladonna seed is much lighter than the average. It is a question of specific gravity, there being no relationship as to size. In order to determine the percentage of the seed, which is generally found to be inferior as to weight, a method of separating the light from the heavy, based on the specific gravity of the seed, was used, which was briefly as follows: 10 Gms. of seeds previously cleaned from husks and all inert matter are thrown into a tall, lipped beaker of 1 litre capacity and half full of water. After thorough stirring to enable all the seeds to become wet, the water is brought to a stop and the heavy seeds allowed to settle on the bottom, while the light ones remain on or near the surface. The latter are then carefully decanted into a Gooch crucible (the perforations in such a crucible are just small enough to prevent the seeds from going through) attached to a vacuum flask. With a strong current of air pulling through the crucible and occasional stirring the seeds are soon dry and can then be weighed. The heavy seeds are filtered off and dried in a similar way. According to this method, six 10-gramme portions from one general lot of seeds were separated into the light and heavy portions to determine the accuracy of the method. The volume of each portion was determined by placing the seeds in a

tall and very narrow graduated cylinder containing about 1 Cc. to the inch, and the scale divided into tenths. Table IV summarizes the result.

TABLE IV.

Relative Per Cent. of Light and Heavy Seed in a General Lot Formed by Separation According to Specific Gravity.

Portion	Light				Heavy			
	Weight		Volume		Weight		Volume	
	Gms.	Per cent.	Cc.	Per cent.	Gms.	Per cent.	Cc.	Per cent.
1	8.25	82.5	16.1	84.3	1.75	17.5	3.0	15.7
2	7.81	78.1	15.5	81.6	2.19	21.9	3.5	18.4
3	8.12	81.2	16.1	84.7	1.88	18.8	2.9	15.3
4	8.53	85.3	17.2	88.2	1.47	14.7	2.3	11.8
5	8.68	86.8	17.4	88.4	1.32	13.2	2.3	11.6
6	8.05	80.5	15.8	82.3	1.95	19.5	3.4	17.7
Average	8.24	82.4	16.35	84.9	1.76	17.6	2.9	15.1

The results show that the method of separation is fairly accurate within certain limits. Seeds from five individual plants were then separated according to the method just described, with the results as shown in Table V.

TABLE V.

Proportion of Light and Heavy Seed from Five Individual Plants.

Number of plant	Light				Heavy			
	Weight		Volume		Weight		Volume	
	Gms.	Per cent.	Cc.	Per cent.	Gms.	Per cent.	Cc.	Per cent.
15	6.26	62.6	11.6	65.2	3.74	37.4	6.2	34.8
47	5.46	54.6	10.9	58.9	4.54	45.4	7.6	41.1
41	7.98	79.8	16.0	84.7	2.12	21.2	3.0	15.3
11W	7.90	79.0	15.4	83.7	2.10	21.0	3.0	16.3
14	5.34	53.4	10.0	56.2	4.66	46.6	7.8	43.8

There appears to be a considerable difference in the proportion of light and heavy seeds in the above individuals, while in all of them the proportion of heavy seeds is considerably greater than in the

general lot used in testing the method of separation. Table VI shows the weight of 500 of the light and the heavy seeds from the five individual plants.

TABLE VI.

Weight of 500 Each of Light and Heavy Seeds from Individual Plants.

Description	Weight (Gms.)				
	No. 15	No. 47	No. 41	No. 11W	No. 14
Light.....	0.4606	0.4101	0.4757	0.5161	0.4409
Heavy.....	0.5105	0.4611	0.5288	0.5610	0.4646

To test the relative germinating power of the light and heavy seeds, fifty of each were sown in five different pots, one for each of four individual plants. Table VII shows the germination at various stages.

TABLE VII.

Relative Germination of Light and Heavy Seeds from Four Individual Plants. Seeds Sown April 13th.

Number of plant	Description of seed	Germination							
		Number				Per cent.			
		May 8	May 15	May 22	May 29	May 8	May 15	May 22	May 29
47.....	Light	3	7	7	8	6	14	14	16
	Heavy	19	24	24	24	38	48	48	48
41.....	Light	3	5	5	5	6	10	10	10
	Heavy	3	8	12	14	6	16	24	28
11W.....	Light	4	5	5	6	8	10	10	12
	Heavy	9	21	24	26	18	42	48	52
14.....	Light	0	1	1	1	0	2	2	2
	Heavy	27	31	32	32	54	62	64	64

The results show conclusively that the light seed is mostly dead, only a small percentage of it germinating. Figure 3 shows graphically the progressive germination in each case.

RELATION OF COLOR OF THE SEED TO THE GERMINATION.

Belladonna seeds are either of a rich brown or silver gray color. That a relationship might exist between color and weight was con-

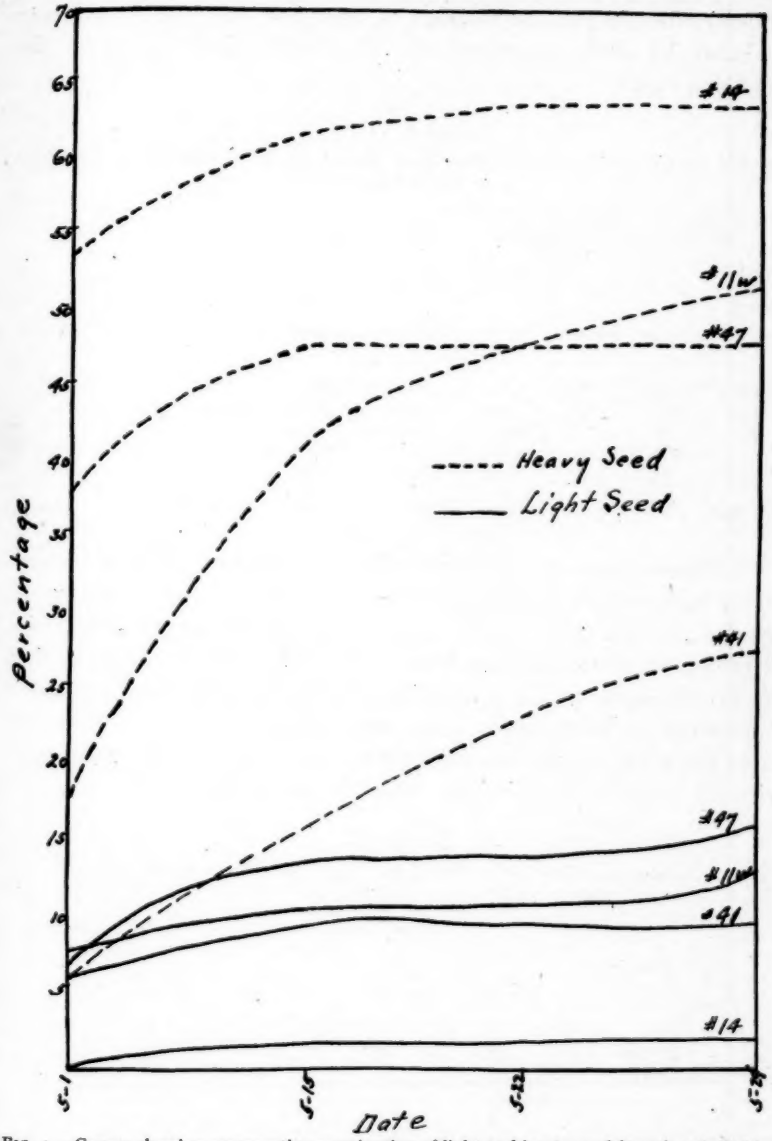

FIG. 3.—Curves showing comparative germination of light and heavy seed from four individual plants.

sidered probable, and for that reason the lots of 500 seeds each used to determine the relative weights of light and heavy seeds as given in Table VI were separated into the brown and gray, with the following result:

TABLE VIII.

Relative Number of Brown and Gray Seed Among the Light and Heavy Seed from Five Individual Plants.

Number of plant	Light				Heavy			
	Brown		Gray		Brown		Gray	
	Number	Per cent.	Number	Per cent.	Number	Per cent.	Number	Per cent.
15	37	7.4	463	92.6	387	77.4	113	22.6
47	397	79.4	103	20.6	471	94.2	29	5.8
41	86	17.2	414	82.8	39	7.8	461	92.2
14	460	92.0	40	8.0	500	100	0	0.0
11w	65	13.0	435	87.0	241	48.2	259	51.8
Average	209	41.8	291	58.2	328	65.6	172	34.4

Evidently there is no definite relation between color and weight, as the results show a great variation. According to the average, it appears that the heavy seeds contain a noticeably larger percentage of brown ones than the light seeds. From this one would judge that the brown seeds are of a better quality and would show a greater percentage of germination. To determinate whether such is the case, 100 seeds of the two colors were sown in pots on April 13th, with the result as indicated in Table IX following.

TABLE IX.

Relative Germination of Brown and Gray Seeds Sown April 13th.

Description	Germination			
	May 8 Per cent.	May 15 Per cent.	May 22 Per cent.	May 29 Per cent.
Brown.....	13	28	42	45
Gray.....	28	42	53	56

These results are quite contrary to what was expected. Table VIII shows that the heavy seed from plant No. 14 contained no grays whatever, while the light seed from the same plant was almost all gray. Reference to Figure 3 shows that the heavy seed ger-

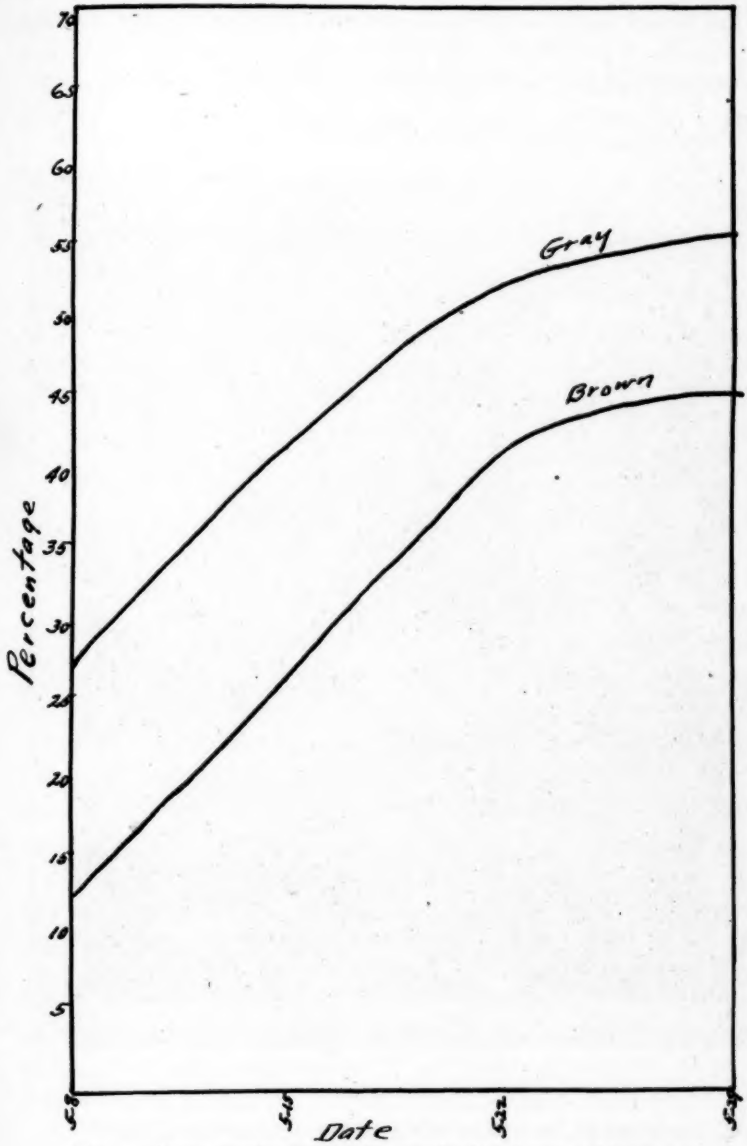

FIG. 4.—Curves showing comparative germination of gray and brown seed.

minated much better than the light. From this it would seem to follow that the brown seeds were much superior to the grays, but, in view of the results obtained from the test, it must be concluded that there is no definite relation between the color and the germinating power. Figure 4 will serve to bring out more clearly the results of the test.

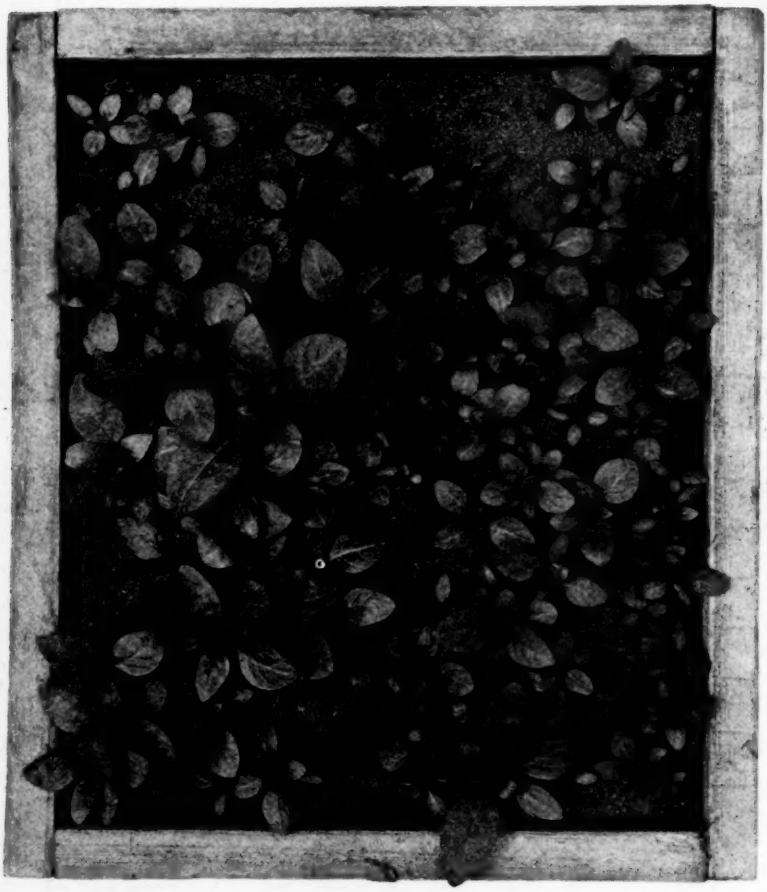

FIG. 5.—Plants from 300 large belladonna seeds seven weeks after sowing.

TREATMENT OF THE SEEDS WITH SULPHURIC ACID.

Probably the most striking and, at the same time, most undesirable characteristic of the germination of belladonna seed is the lack of uniformity it displays. The first seeds usually begin to ger-

minate in about three weeks after sowing. The bulk of the seeds germinate between the fourth and fifth week. After that the progress is slow, a few per cent. of the total appearing every week for probably several months. Figure 5 illustrates this lack of uniformity in germination.

It has often been observed that new plants will appear after the others sown at the same time are seven to eight inches high. In some cases this might be due to lack of uniformity in sowing as regards character and condition of soil and depth of soil covering the seed. This might be especially true when sowing in the field. In greenhouse work, however, such conditions are generally avoided, and a different explanation must be found. It was thought that possibly these slowly germinating seeds might be what are generally known as "hard-heads," that is, seeds with such heavy outer walls that the necessary warmth and moisture essential to germination can penetrate but slowly. It is well known that with such seeds germination can sometimes be hastened by treating them with some substance like strong corroding acids that will partly disintegrate the outer covering of the seed. Such treatment, of course, is fatal if allowed to go too far.

Miller [1] found concentrated sulphuric acid beneficial when applied for a period ranging from five to fifteen minutes, the ten-minute application giving by far the best results. He does not state, however, the actual percentage of germination obtained by means of the treatment. T. B. Young found a five-minute treatment with concentrated sulphuric acid very beneficial, but concluded that a ten-minute treatment would be too long. Here again data as to the actual percentage of germination are not available.

To obtain further information on this subject, belladonna seed was subjected to sulphuric acid of various strengths and for various periods as shown in Table X.

A convenient quantity of seeds were treated for the required length of time with acid of the desired strength in a small beaker and then quickly transferred to a Gooch crucible attached to a vacuum flask and rapidly and repeatedly washed with water. They were then dried by pulling air through the crucible.

To determinate the relative germination of these treated seeds,

[1] Miller, Fred A., "The Propagation of Medical Plants," *Bulletin of the Torrey Botanical Club*, vol. 41, No. 2, pp. 105–136.

TABLE X.

Showing Strength of Acid Used, Time of Treatment, and Designation of the Seed in Each Case.

Strength of acid	Time treated			
Per cent.*	1 minute	10 minutes	30 minutes	60 minutes
92.5	A_1	A_2	A_3	A_4
75	B_1	B_2	B_3	B_4
50	C_1	C_2	C_3	C_4
25	D_1	D_2	D_3	D_4

* By volume.

TABLE XI.

Relative Germination of Seeds Treated with Sulphuric Acid and Sown on March 31st.

	Germination									
	Number					Percentage				
	4–24	5–1	5–8	5–15	5–22	4–24	5–1	5–8	5–15	5–22
A_1.....	1	7	26	29	32	1.66	11.6	43.3	48.3	53.3
A_2.....	9	22	35	35	35	15.0	36.6	58.3	58.3	58.3
A_3.....	2	3	3	3	3	3.3	5.0	5.0	5.0	5.0
A_4.....	0	0	0	0	0	0	0	0	0	0
Total..	12	33	65	68	70	51.	17.8	27.1	28.3	29.2
B_1.....	0	4	24	26	29	0	6.6	40.1	43.3	48.3
B_2.....	1	11	34	34	34	1.66	18.3	56.6	56.9	56.6
B_3.....	5	14	30	30	30	8.3	23.3	50.	50.	50.
B_4.....	0	2	3	3	3	0	3.3	5.	5.	5.
Total..	6	31	91	93	96	2.5	13.	37.9	38.7	40.
C_1.....	0	2	26	34	39	0	3.3	43.3	56.6	65.
C_2.....	0	9	37	38	41	0	15.	61.6	63.3	68.3
C_3.....	0	5	26	31	31	0	8.3	43.3	51.6	51.6
C_4.....	0	2	19	23	24	0	3.3	31.6	38.3	40.
Total..	0	18	108	126	135	0	7.5	45	52.5	56.2
D_1.....	0	4	26	26	26	0	6.6	43.3	48.3	48.3
D_2.....	0	4	25	28	28	0	6.6	41.6	46.6	46.6
D_3.....	0	6	34	36	36	0	10.	56.6	60.	60.
D_4.....	0	7	25	25	26	0	11.6	41.6	41.6	48.3
Total..	0	21	110	115	116	0	8.75	45.8	47.9	48.3

sixty of each were placed in pots on March 31st. Table XI shows the result.

These results seem to demonstrate a number of facts. The

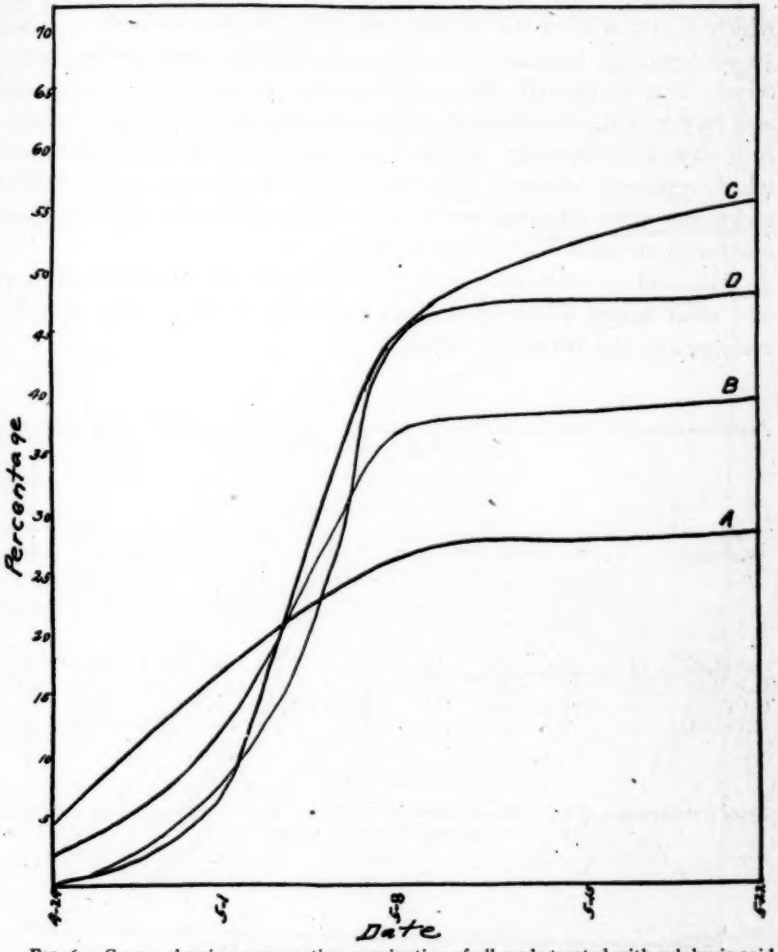

FIG. 6.—Curves showing comparative germination of all seeds treated with sulphuric acid of 92.5 per cent. (*A*), 75 per cent. (*B*), 50 per cent. (*C*), and 25 per cent. (*D*). Seeds were sown March 31st.

effect of the acid treatment as conducted in this experiment is of little practical value, the only benefit derived being that of a slight acceleration in germination. The total germination is not found to be any greater, on the whole, than in the case of seeds not subjected

to the treatment. It is evident that contact with concentrated (92.5 per cent.) sulphuric acid destroys the germinating power almost completely if continued longer than ten minutes. Treatment with 75 per cent. acid may be continued for thirty minutes without injury, which is also true of the 50 per cent. acid. When the acid is below 50 per cent. the time of contact up to one hour seems to be immaterial. It is noteworthy that only the seeds treated with concentrated and 75 per cent. acid showed any germination on April 24th, twenty-four days after sowing. In the following week, however, the seeds which received treatment with the 50 and 25 per cent. acids showed about the same germination as the others, and from then on they continued to show to better advantage.

In order to indicate more clearly what concentration of acid and what length of treatment are the most desirable, the data are arranged in the following tables.

TABLE XII.

Total Germination of all Seeds Treated with 92.5, 75, 50, and 25 Per Cent. Sulphuric Acid for Different Lengths of Time.

Treatment	Germination									
	Number					Per cent.				
	4–24	5–1	5–8	5–15	5–22	4–24	5–1	5–8	5–15	5–22
$A_1A_2A_3A_4$	12	33	65	68	70	5	17.8	27.1	28.3	29.2
$B_1B_2B_3B_4$	6	31	91	93	96	2.5	13	37.9	38.7	40.
$C_1C_2C_3C_4$	0	18	108	126	135	0	7.5	45	52.5	56.2
$D_1D_2D_3D_4$	0	21	110	115	116	0	8.75	45.8	47.9	48.3

TABLE XIII.

Total Germination of all Seeds Treated for 1, 10, 30, and 60 Minutes with Sulphuric Acid of Various Strengths.

Treatment	Germination									
	Number					Per cent.				
	4–24	5–1	5–8	5–15	5–22	4–24	5–1	5–8	5–15	5–22
$A_1B_1C_1D_1$	1	17	102	115	126	0.4	7.	42.5	47.9	52.5
$A_2B_2C_2D_2$	10	46	131	135	138	4.2	19.2	54.6	56.2	57.5
$A_3B_3C_3D_3$	7	28	93	100	100	2.9	11.7	38.7	41.7	41.7
$A_4B_4C_4D_4$	0	11	47	51	53	0.0	4.5	19.5	21.2	22.1

TREATMENT OF SEEDS WITH HYDROGEN PEROXIDE.

It has been found that hydrogen peroxide has an accelerating influence on the germination of a large number of seeds, and for that reason the following experiment was undertaken to determine

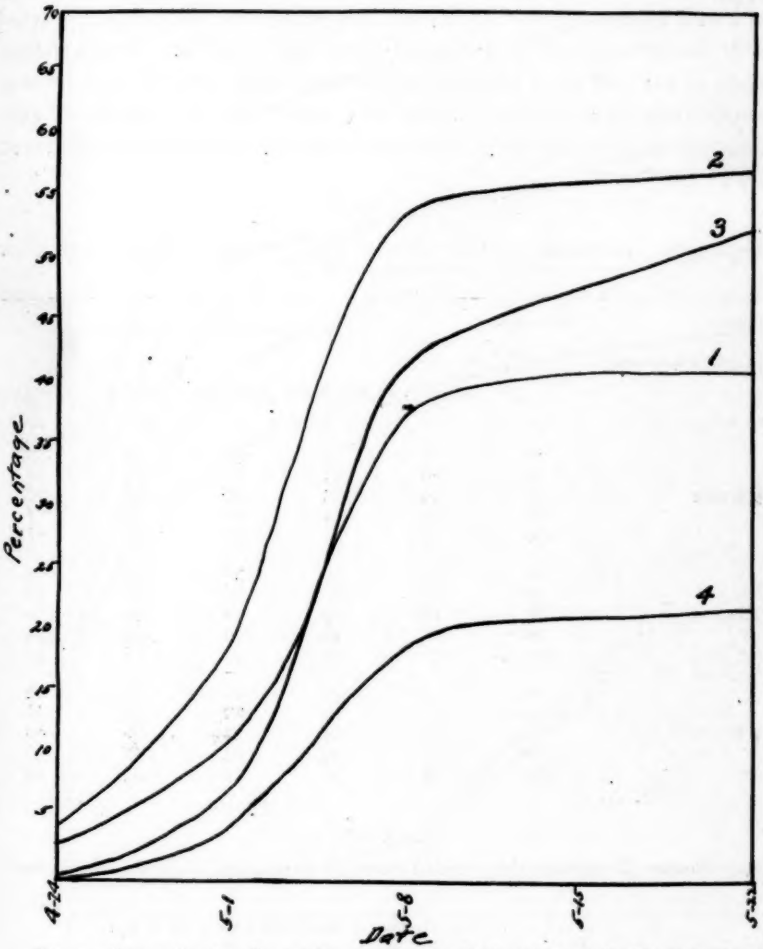

FIG. 7.—Curves showing comparative germination of all seeds treated with sulphuric acid for 1 minute (1), 10 minutes (2), 30 minutes (3), and 60 minutes (4). Seeds were sown March 31st.

whether belladonna seed yielded to such treatment. The hydrogen peroxide used was the commercial kind containing 40 per cent. of absolute peroxide. This strength is designated in the tabulations

as 100 per cent. The weaker solutions designated as 80, 60, 40, and 20 per cent. in the tabulations were made by diluting the commercial material on the basis of 100 per cent. A small lot of the seeds was treated with the various solutions of peroxide for 18 hours. The treatment was duplicated with another lot of seeds for 24 hours and with still another lot for 48 hours. All seeds were immediately dried after the removal of the peroxide in a Gooch crucible. One hundred seeds of each lot were planted on February 16th and the germination noted from time to time. Table XIV shows the percentage of germination in each case up to April 9th, when the germination appeared to be completed.

TABLE XIV.

Comparative Germination of Seeds Treated with Hydrogen Peroxide and Sown February 16th.

Time of treatment	Strength of hydrogen peroxide used, per cent.	Percentage of germination				
		March 13	March 19	March 25	April 2	April 9
18 hours	20	11	31	32	34	35
	40	18	56	60	64	64
	60	19	63	66	69	69
	80	13	61	62	65	67
	100	14	29	35	40	41
24 hours	20	32	52	58	59	59
	40	22	60	68	70	70
	60	18	39	48	52	52
	80	28	36	40	44	44
	100	27	39	40	44	45
48 hours	20	17	41	49	50	55
	40	12	24	29	34	39
	60	34	54	55	60	60
	80	23	49	53	55	56
	100	16	37	39	43	44

TABLE XV.

Total Number Germinated of all Seeds Treated for 18, 24, and 48 Hours, Respectively.

Time of treatment	Number of seeds germinated out of 500				
	March 13	March 19	March 25	April 2	April 9
18 hours	75	240	255	272	276
24 hours	127	226	254	269	270
48 hours	102	205	225	242	254

Figures 8 and 9 show graphically the effect of the treatment with peroxide, both as to the strength of the solution used and the time of treatment.

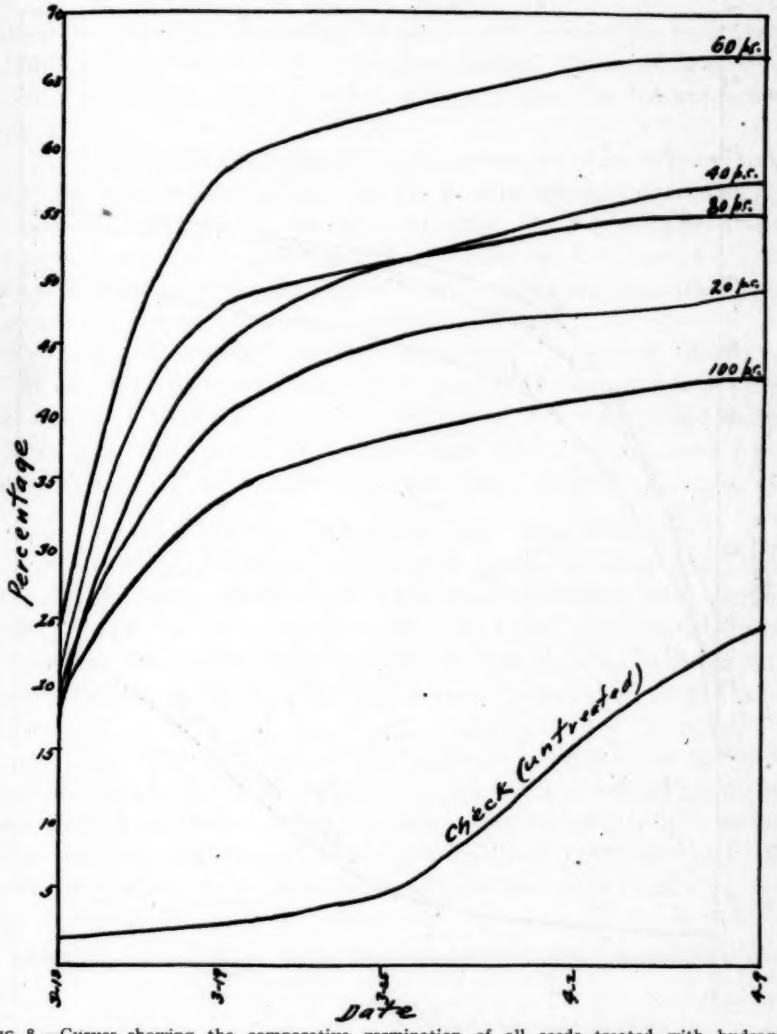

FIG. 8.—Curves showing the comparative germination of all seeds treated with hydrogen peroxide of 20, 40, 60, 80, and 100 per cent. strength. Seeds sown on February 16th.

It is evident that the treatment with hydrogen peroxide is of very appreciable benefit. The percentage of germination during the first four or five weeks, when compared with that of the untreated seeds

used as a check, is much greater than was expected. It appears, from the check, that this lot of seeds would be especially slow in germinating under ordinary conditions, though the total germination would

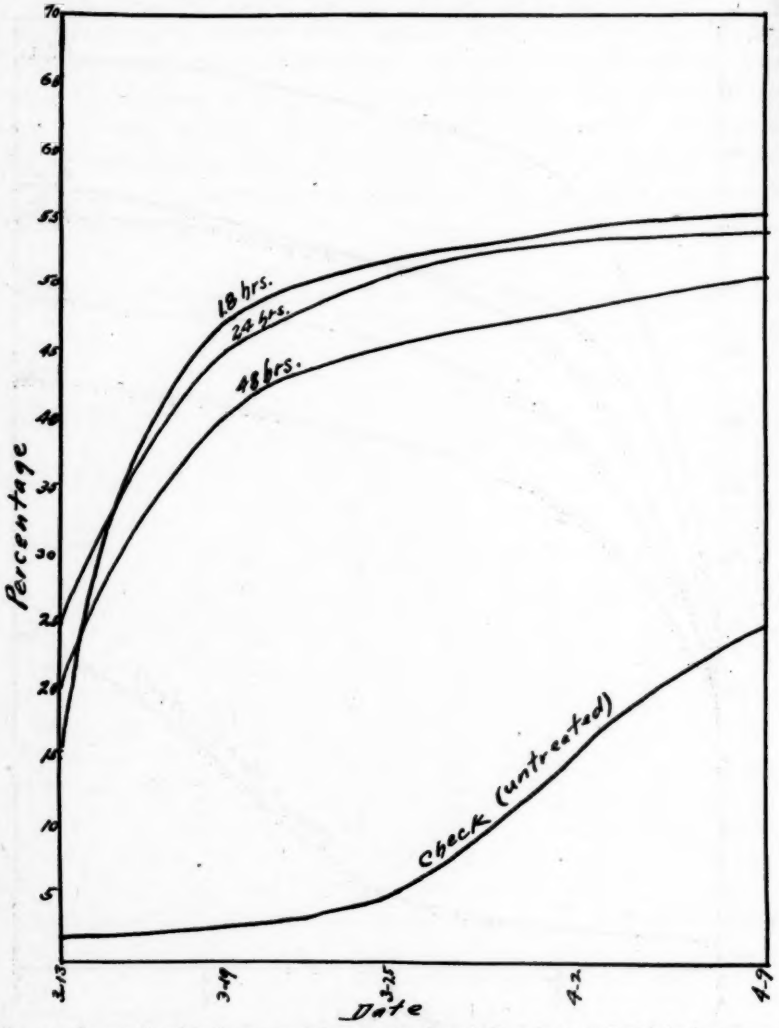

FIG. 9.—Curves showing the comparative germination of all seeds treated with hydrogen peroxide for 18, 24, and 48 hours. Seeds sown February 16th.

probably compare favorably with the usual average. The maximum germination secured by the peroxide treatment was 70 per cent., while the minimum was 35 per cent. Taken as a whole, the effect

of the peroxide seems to have been to induce a uniformity in the germination rather than an acceleration or an actual increase in percentage. From these experiments and from those with sulphuric acid it seems that when working under conditions such as those described the effect of treating the seeds with chemicals is to induce a uniformity or spontaneity in the germination. The seeds, however, seem to require as much time to begin germination as the untreated seeds.

As regards the concentration of the peroxide used, it is evident that neither the concentrated nor the greatly diluted material is of as much benefit as the medium strengths. It will be seen from Figure 8 that the 60 per cent. solution gave the best results. The 80 and 40 per cent. solutions gave results very much alike, while the 20 and 100 per cent. solutions had the least effect.

The time of treatment does not seem to make any great difference. The 18- and 24-hour treatment gave very similar results, while the 48-hour treatment was not quite so effective. It is evident that there is no benefit in treating the seeds longer than 18 hours, and it is possible that a shorter period would be just as effective.

The Effect of Scratching the Seed Coats.

Many seeds germinate very slowly, owing to their hard and thick coats, which do not admit of a rapid permeation of moisture and air into the seed. Such seeds have often been benefited by scratching the surface by some mechanical means, so as to hasten the absorption of moisture, with a consequent acceleration of the germination.

To determine the effect of such methods on belladonna seeds, a quantity of the seed was shaken in a bottle with powdered glass for one and a half hours. Another quantity was rubbed gently between two sheets of fine emery paper. One hundred seeds from each lot were planted as a test. The following table shows the result:

Table XVI.

Comparative Germination of Belladonna Seed Scratched with Powdered Glass and Emery Paper. Seeds Sown February 16th.

Treatment of seed	Percentage of germination					
	March 13	March 19	March 25	April 2	April 9	April 16
Check (untreated).....	2	3	5	16	25	33
Shaken with powdered glass.	3	18	21	34	45	47
Rubbed with emery paper...	0	11	17	22	26	28

The effect of scratching does not appear to be as great as was expected. The shaking with sand gave better results than the emery treatment. Figure 10 shows the results graphically.

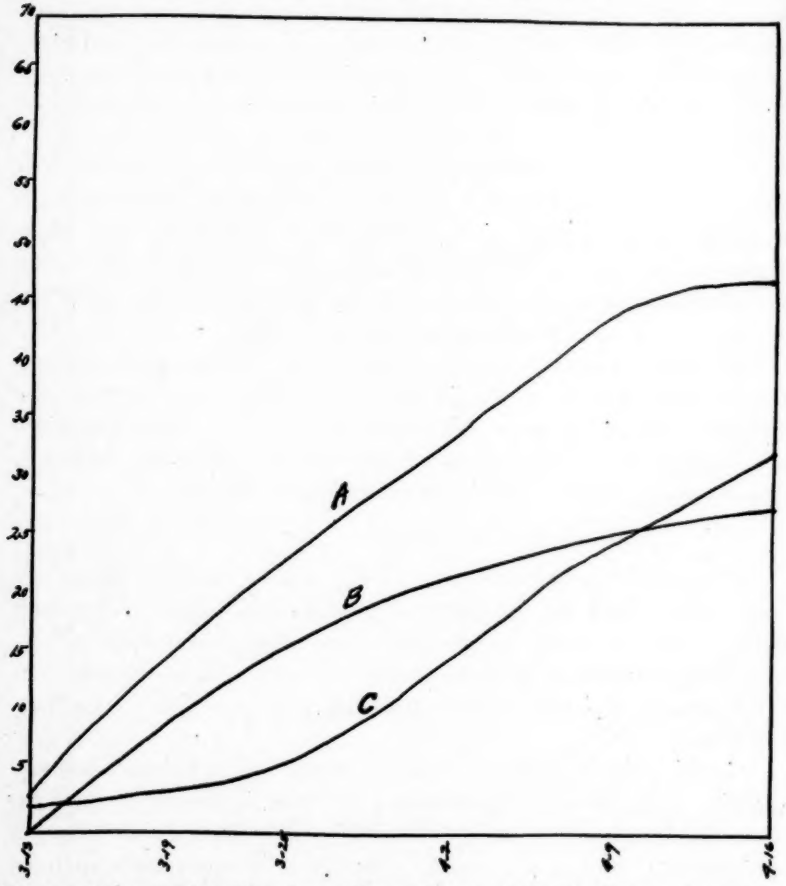

FIG. 10.—Curves showing effect of scratching seed coats. (*A*) Seeds shaken with powdered glass; (*B*) seeds rubbed between emery paper; (*C*) check. Seeds sown February 16th.

SUMMARY.

The subjection of belladonna seed to freezing temperatures accelerates their germination. Hence it is of benefit to sow the seed in the fall in order to insure a rapid and early germination in spring.

There appears to be no relationship between the size of the seed and its germinating power. This must not be taken to indicate that a relationship does not exist between the size of the seed and the vigor and strength of the plant.

The heavy seeds are by far the best. The percentage of germination of the light seeds is very small. Separation of these inert seeds can be readily effected by immersing the seed in water and discarding those which do not sink. The proportion of light and heavy seed from each individual plant varies greatly. This may be due partly to carelessness in picking the berries, as unripe berries contain light and worthless seeds. The question of drying is also of importance. The berries must be thinly scattered and dried in a well-ventilated room, in order to reduce molding to a minimum. It is probable that a certain percentage of the seed in a fully developed berry is inert, which would account to some extent for the relatively low percentage of germination of the average belladonna seed.

Color appears to be no criterion of the value of the seed as regards germinative power. The brown seeds have a better appearance, but apparently the gray ones have equal vitality.

While other investigators have found that treatment with concentrated sulphuric acid from one to ten minutes is of benefit, experiments with various strengths of acid for periods ranging from one to sixty minutes showed that, as a whole, the treatment is not of any great value. The germination was accelerated in some instances, but no material increase in actual germination was noted.

Treating seeds with hydrogen peroxide was found to be of very material benefit. Eighteen and twenty-four hours gave better results than longer treatment. A 6o per cent. solution of the commercial hydrogen peroxide gave the best results. The concentrated solution was the least beneficial.

Scratching the seed coats by shaking in a bottle with powdered glass and by rubbing between sheets of emery paper, while of some benefit, was not nearly as beneficial as the peroxide treatment.

MEDICINAL PLANT GARDENS.*

By Dr. W. W. Stockberger, Physiologist in Charge of Drug-Plant and Poisonous-Plant Investigations, Bureau of Plant Industry, United States Department of Agriculture.

It is not my intention in this paper to present a descriptive account of medicinal plant gardens in general, or even to discuss the more important ones of this country, except in so far as reference to them may be necessary by way of illustration. I shall endeavor, however, to point out what to me appear to be some popular misconceptions concerning the scope and function of such gardens, and to suggest how they may be made to increase their usefulness to Materia Medica and Pharmacognosy.

For the purpose of this discussion, medicinal plant gardens may be regarded as falling under one of two general classes, the first being pedagogic, the second industrial. The pedagogic garden is, naturally, an adjunct of a school of pharmacy or of a botanic garden. Its scope includes all medicinal plants that are adapted to existing soil and climatic conditions, supplemented by greenhouse facilities. Its function is to familiarize students with the habit and appearance of the entire living plant, some part of which is used as a plant drug, to supply the need for authentic specimens for observation and demonstration in the classroom, and to furnish materials for research work on the morphology and chemical constituents of drug plants. Necessarily it will be found desirable to grow a large number of species in this type of garden, but, owing to the cost of maintenance, the space which can be devoted to any one species will be very small.

The industrial garden, on the other hand, is an adjunct of public or private enterprise, the object of which is to give additional information concerning our agricultural resources. Its scope is the same as that of the pedagogic garden, but it differs very materially in function, which is to serve for the determination of the adaptability of medicinal plants, not only to soil and climatic conditions, but to economic conditions as well. In the industrial garden a large number of species will be tested on a small scale to determine whether the soil and climate are suitable for their growth; then the

* A paper read before the Scientific Section of the A. Ph. A. at the Detroit meeting, 1914.

few promising ones must be tried out on an area large enough to yield reliable data on the actual conditions of commercial production. A considerable acreage of land is indispensable for this type of garden if the results secured therein are expected to have much economic significance.

There is no lack of evidence that the general public often, if not as a rule, fails to differentiate the functions of the pedagogic and industrial gardens, since advice is freely sought from both regarding the production of medicinal plants for the sole purpose of deriving profit therefrom. It is also an open question whether this distinction in function is in every case clearly understood by those responsible for the management of medicinal plant gardens. Statements sometimes unguarded, or not properly qualified, and sometimes based upon inconclusive and insufficient data, have on several occasions inspired the imagination of writers for the popular magazines or daily press, and, as a result, visions of large and easy profits have been portrayed under various alluring titles, as, for example, "Big Profit from Drug Weeds," "The Herb Grower Has a Chance at an $18,000,000 Business," "A Profit of One Hundred Dollars per Acre from Growing Medicinal Weeds." Moreover, the widespread interest in the possibility of growing medicinal plants for profit which has been developed in this country during the past decade has been capitalized by a number of crafty promoters, who use the mails and the columns of journals and magazines to disseminate flamboyant advertisements of the enormous profits which may be made by growing certain medicinal plants. Frequently the name of the plant is withheld until the victim has remitted from one to five dollars, for which he receives practically valueless instructions for the cultivation of some plant poorly adapted to our economic conditions. A typical get-rich-quick scheme of this class is explained thus: "It has to do with a certain plant which grows like a weed; it is cut and cured like hay and sells for 45 cents per pound, which is at the rate of $900 per ton." The investment of one dollar brings the name of the herb, with the further information that the product of one acre will sell for $1800! As a matter of fact, the commercial cultivation of this plant is almost unknown in the United States, and there is yet no established market for the American product.

These illustrations will account for the doubt which has arisen

in my mind as to the propriety of purely pedagogic gardens being used as a basis for generalizing on the question of drug growing for profit. In agricultural experimentation it is well recognized that the results from small trial plots must be interpreted with due regard for the large factor of error, which is always present. With proper care and attention it is relatively easy to grow a luxuriant crop of any one of a number of drug plants on a square rod of good garden soil, but what can be done under ordinary agricultural conditions on one or more acres can not be calculated therefrom by "a simple sum in arithmetic," as one writer has naïvely said.

There are numerous well-authenticated instances in which the production of some medicinal plant has resulted in a fair profit, but there is yet no evidence at hand to justify the belief that satisfactory results can be secured without some practical experience in gardening, some knowledge of the requirements of crude drugs, and due regard for economic conditions.

Every pharmacist and physician is, or should be, interested in obtaining crude drugs of highest quality and standard efficiency, but material progress toward the attainment of this end will not be favored by encouraging a large number of persons to become small producers. The result of small individual collections, varying widely as to time, place, and method of gathering, is seen in the miscellaneous aggregates all too frequently found in our crude drug markets, and unless a perpetuation of this condition is desirable, little encouragement should be given to the suggestion that whoever has a small back yard available may become a producer of plant drugs.

The educational opportunity open to the pedagogic gardens is almost limitless. The dissemination of knowledge to countless individuals not having access to the garden itself regarding the history, geographic distribution, methods of preparation, and uses of crude drugs may be accomplished through illustrated lectures and carefully prepared articles written for the less technical periodicals. Such misconceptions as, for example, that the production of ipecac in New England and vanilla beans in Iowa is a commercial possibility, or that stramonium is produced by a "melon weed," are all too prevalent and should be corrected. But educational work along this line deserves little tolerance unless inspired by some motive more commendable than that of merely arousing interest in growing

drug plants, otherwise the whole movement will sooner or later be discredited. Recently a reputable pharmaceutical journal published an article in which the writer set forth at some length the possibilities for the commercial production of a certain drug plant in the Southwest. A request for further information brought forth from this writer the astounding statement that he had no personal knowledge of conditions in the Southwest, but, *having grown this plant in one of the northern States,* he saw no reason why it should not be profitably grown in the Southwest, " on rocky and otherwise unprofitable land, on hillsides or arid desert soil." In this case the motive was evidently merely the arousing of interest, and the writer mentioned displayed a fine disregard for the practical difficulties attending the growing of the plant in question, which sharply localize the areas on which it may be economically produced.

The time is certainly ripe for injecting into discussions and recommendations regarding the cultivation of medicinal plants some of the sanity and discrimination which characterizes conservative business operations. Such a course is necessary if the interest already aroused is to be retained and directed along lines productive of beneficial results. It should be remembered that the expense of agricultural operation varies widely according to location. In some localities the outlay for farm labor will be three and one-half times as much as in others. Sometimes we find a low expense for labor associated with a heavy outlay for fertilizers, sometimes heavy expense for both labor and fertilizers, and, again, low expense for both. The complications introduced by these factors alone render it practically impossible to make any safe general statement as to the profitableness of drug growing. Furthermore, two localities separated by a distance of less than fifty miles may present a totality of conditions so different that a drug-growing enterprise which could probably be conducted at a profit in the one would with equal probability fail absolutely in the other.

I do not wish to be understood as taking the position that there is no opportunity in the cultivation of medicinal plants, for I have abundant evidence that, given the *necessary favorable conditions,* a fair return may be expected from several drug crops. On the other hand, I also have abundant evidence that hundreds of persons have received the impression that drug crops can be grown by anybody anywhere at a profit far in excess of that to be obtained from ordi-

nary cultivated crops. I am convinced that in some cases optimism and enthusiasm have been allowed to outrun common sense, but if, in the future, due consideration is given to the fundamental principles of agricultural economics, I believe that a rational attitude toward commercial drug-plant cultivation may be developed.

The founders of the several excellent pedagogic gardens which are now maintained in connection with certain schools of pharmacy have inaugurated a movement which promises much for the future of Materia Medica and Pharmacognosy. It is sincerely to be hoped that their example will lead to the establishment of such gardens in connection with each of the 75 or more schools of pharmacy in the United States, and to an extension of the scientific study of medicinal plants. The problems demanding attention are very numerous, but some of the lines of study and investigation which need to be emphasized are those concerning the adaptation and acclimatization of medicinal plants, the conditions under which the active principles of plants are formed, and the behavior of the plants themselves under varying conditions of climate and culture. Moreover, the selection and breeding of medicinal plants not only promises to yield results of great practical importance, but also affords a field for the widest scientific activity.

It is to be regretted that at present there is no satisfactory way in which the investigations being made upon medicinal plants in different sections of this country can be properly correlated and reduced to form for definite comparison. Especially desirable is a practical basis of correlation for studies of the variation in plant constituents, due in part, at least, to differences in geographical location. When two more or less widely separated workers attempt to compare the results of their studies, it frequently happens that they experience the greatest difficulty in harmonizing their results. This is due in part to differences in the response which plants make when under different environmental conditions, in part, probably, to variations in the method of procedure followed in the cultivation, curing, and analysis of the plant, and in part, no doubt, to differences in the genetic relationship of the plants studied by the respective investigators.

There seems to be an opportunity for some arrangement or mutual agreement between the representatives of our various medicinal plant gardens under the terms of which multiplicate samples of seeds

or plants of common parentage could be distributed for the production of plants to be used experimentally. If under such an agreement uniformity of treatment throughout the processes of culture, curing, and analysis could be secured, comparison of results would be much more profitable than at present, and the tabulation and summarizing of the results of experimental work conducted along the lines indicated in a number of localities would permit the drawing of conclusions having a significance far greater than those that can be reached by a single isolated worker. The suggestions here offered contemplate nothing like a general coöperative investigation, but rather the adoption of what might be regarded as a standard method of procedure analogous to official methods of analysis, etc. The tabulation and summarizing of results might well follow individual publication, as no other course is likely to give satisfaction.

In conclusion, I wish to say that the resources of the experimental drug gardens of the Office of Drug-Plant Investigations, Bureau of Plant Industry, are open to any school of pharmacy desirous of starting a medicinal plant garden, as are also the facilities of that office for effecting the distribution of material for experimental purposes, and for furthering the collection and compilation of data on the cultivation of medicinal plants under great diversity in conditions of growth.

BUREAU OF PLANT INDUSTRY,
United States Department of Agriculture,
August 18, 1914.

A STUDY OF SOME OF THE METHODS FOR THE DETERMINATION OF CALOMEL IN CALOMEL TABLETS.

By J. W. MARDEN and O. E. CUSHMAN.

In the determination of calomel in calomel tablets there is a choice of several methods of procedure. Since the composition of calomel tablets varies considerably, different methods apply better to some samples than to others, and care must be exercised in selecting a method which will give correct results; many fillers, such as talc, sodium bicarbonate, gum acacia, confection of rose, etc., are often found.

Possibly the most widely used method for the analysis of mercurous mercury is the gravimetric estimation as the sulphide.[1] In this

[1] Treadwell-Hall, *Anal. Chem.*, vol. ii, p. 168; Olsen, Quant. Chem. Anal., p. 79.

method it is necessary to oxidize the mercury in order to get it into solution, and for this oxidation strong acids, aqua regia, free chlorine, or some other suitable reagents are commonly used. When the mercury is completely oxidized the strong acids are nearly neutralized and the clear solution treated with hydrogen sulphide. The mercuric sulphide thus precipitated always contains free sulphur, and this must be removed before the sulphide can be dried and weighed. The precipitate is therefore washed thoroughly with dilute hydrogen sulphide water and finally washed repeatedly with carbon disulphide to remove the free sulphur.

There are at least three objectionable points in this method. First, the length of time required for a determination (which depends, of course, upon the modification used) is much too long for the average analyst. Second, the difficulty of obtaining complete oxidation is very great. Certain fillers seem to add to this difficulty, and talc, if it is present, remains suspended in the solution. In such a case there is no way of determining when the reaction is complete. The use of strong acids for the oxidation is inadvisable because of the difficulty in removing the excess of acids before the precipitation of the sulphide, and, according to Treadwell, the nitric acids in the aqua regia, if this is used, can not be removed by evaporation because of the volatility of the mercuric chloride. It was found that oxidation with free chlorine in alkaline solution is the most successful, as the proper degree of acidity for complete precipitation with hydrogen sulphide is more easily attainable here than in the methods employing concentrated acids. Third, although a number of modifications of this method have been suggested for the extraction of the free sulphur with carbon disulphide, none of these have been found to give very satisfactory results. It is apparent that it is very difficult to wash out occluded sulphur from precipitates unless they are finely divided. Mercuric sulphide precipitates, under ordinary circumstances, in clots which can not be easily disintegrated, and considerable experience has shown that extraction with the Soxhlet apparatus for many hours does not remove the sulphur so that the results obtained could be looked upon with confidence.

According to Merrill,[2] mercury can be determined by the volatilization of the mercurous chloride. In this method the procedure is, roughly, to triturate the tablets in warm water and transfer the

[2] E. C. Merrill, Bureau of Chemistry, Washington, D. C.

solid mercurous chloride to a Gooch crucible which has been previously ignited. The crucible and its contents are washed thoroughly, dried at 110° C., weighed, ignited in a Bunsen burner to drive off the mercurous chloride, cooled, and weighed again. The loss in weight is assumed to be mercurous chloride. This method is shorter and simpler than the sulphide method, but it can not be used for the analysis of certain calomel tablets. It was found in several cases that fillers consisted of some ingredients that were insoluble in water and various organic solvents, but were at the same time volatile or combustible, like cellulose, thus giving a result too high.

A method was also tried for the volatilization of the free mercury after the calomel had been reduced with formaldehyde. Here there is no means of telling when the reduction is complete, and even after considerable effort consistent results were not obtained.

Merrill also suggested a method for the reduction of mercury to the metallic state with formaldehyde, filtering off the free mercury, and determining the chlorine gravimetrically as silver chloride. This is open to the same objections as the preceding method, for complete reduction with formaldehyde is somewhat slow and difficult.

An iodine titration method [3] is suggested by various text-books on quantitative analysis which is rapid and gives good results with most samples of calomel, but very poor results with a few others, success seeming to depend on the character of the filler used. The method consists in treating the tablets, which have been disintegrated with water, with potassium iodide and standard iodine solution in excess, and titrating this excess with sodium thiosulphate solution. A control is run under similar conditions, and the difference between the amount of thiosulphate solution used in the control and the sample represents the iodine consumed by the calomel. The end point in this titration is not decisive and changes on standing. It was found in other cases that the iodine did not react as rapidly as the method indicated, but that after the iodine had been added it was better to allow the solution to stand before titration.

Other methods might be cited, but the above-mentioned are sufficient to indicate the difficulty of devising a method that is at once rapid, accurate, and applicable to all cases. The need for such a method arose in this laboratory by reason of the number of samples

[3] Schimpf, "Manual of Volumetric Analysis," p. 408; Sutton, "Methods of Volumetric Analysis," p. 248.

of calomel received for analysis and the limited amount of time available. A method was devised, which was afterward found to be identical with the method recently suggested by Kohn and Ostersetzer,[4] which seems to very nearly satisfy the conditions. Kohn found that the halogen compounds of mercury could be easily oxidized and made soluble by means of sodium peroxide, and the halogen titrated by Volhard's method with silver nitrate. This method, as it has been used for the results below, is as follows: The tablets, in amount corresponding to 0.2 to 1.0 gm. of Calomel, are first disintegrated in about 30 C.c. of water, made acid with nitric acid to drive off the carbon dioxide from the sodium bicarbonate, which is often used as a filler, and sodium peroxide added, a little at a time, with stirring, until the gray metallic mercury separates out. About one gramme of sodium peroxide is added in excess. After heating for a very few minutes, the precipitated mercury is filtered onto a Gooch crucible and washed with water. The filtrate is strongly acidified with nitric acid, tenth-normal silver nitrate added in excess, and the solution then cooled and agitated, causing the precipitate to coagulate.[5] The excess of silver nitrate is then titrated with potassium sulphocyanate, using ferric alum as an indicator. This method is rapid, requiring only a few minutes for a determination; it is simple, and it was found to give accurate results with all of the samples of calomel tablets tried.

The first table below gives a series of results of the analyses of known amounts of pure, carefully dried mercurous chloride by Kohn's method, using certified burettes for the titrations.

The second table gives the results with mixtures of calomel and sodium carbonate. This will give an idea of about how close tablets consisting of these constituents could be determined by this method.

TABLE I.

No.	Gms. HgCl	Cc. N/10 $AgNO_3$	Cc. N/10 KCNS	Gms. HgCl found	Per cent.
1	0.5000	25.00	3.83	0.4986	99.72
2	0.5000	25.00	3.78	0.4998	99.98
3	0.5000	25.00	3.83	0.4986	99.72
4	0.5000	25.00	3.80	0.4993	99.86
5	0.5000	25.00	3.83	0.4986	99.72
Average per cent.....					99.80

[4] *Zeits. anorg. Chem.*, 80, 218.

[5] Rathmund and Burgstaller, *Zeits. anorg. Chem.*, 63, 330 (1909).

TABLE II.

No.	Gms. HgCl	Gms. Na_2CO_3	Cc. N/10 $AgNO_3$	Cc. N/10 KCNS	Gms. HgCl found	Per cent found in mixtures
1	0.8000	0.2000	40.00	6.13	0.7960	
2	0.8000	0.2000	40.00	6.12	0.7968	79.64
3	0.6000	0.4000	30.00	4.61	0.5981	
4	0.6000	0.4000	30.00	4.56	0.5993	
5	0.6000	0.4000	30.00	4.61	0.5981	59.85
6	0.4000	0.6000	25.00	8.04	0.3996	
7	0.4000	0.6000	25.00	8.06	0.3991	39.94
8	0.2000	0.8000	15.00	8.48	0.1999	
9	0.2000	0.8000	15.00	8.43	0.1985	19.92

It must be admitted that the results obtained for this table are a little low, due either to a passing of the end point in the titration, or to the reverse reaction [6] which occurs when the silver chloride is not removed before the excess of silver nitrate is titrated.

The third table shows some of the results of the analyses of several samples of calomel tablets by the sodium peroxide method and the checks made by some of the other methods of analysis. The table is condensed, showing only the average of duplicate determinations in each case. This table is intended to give an idea of how the amount of calomel found by different methods varies with the conditions imposed by each method.

TABLE III.

No.	Grains per tablet claimed	Grains by sulphide method	Grains by volume of Hg	Grains by volume of HgCl	Grains by iodide method	Grains by Na_2O_2 method	Per cent. of labelled value found by Na_2O_2 method
1	1.000	0.992	....	....	....	1.030	103.0
2	1.000	0.775	....	....	....	0.870	87.0
3	0.250	0.212	0.190	....	....	0.252	100.8
4	1.000	....	1.010	....	....	0.982	98.2
5	1.000	....	1.070	....	....	1.030	103.0
6	0.250	....	0.300	....	....	0.252	100.8
7	0.500	....	....	0.529	....	0.525	105.0
8	0.250	....	....	0.333	....	0.147	98.8
9	0.250	....	....	0.208	0.260	0.204	81.6
10	0.250	....	....	0.230	0.239	0.258	103.2
11	0.500	....	....	....	0.459	0.494	98.8
12	1.000	....	....	....	1.095	0.946	94.6
	Average.....						97.9

[6] Rosanoff and Hill, *J. Am. Chem. Soc.*, 29, 269 (1907).

It will be noted that the results by the sulphide method are somewhat low, due probably to incomplete oxidation of the calomel. The results by the reduction to metallic mercury and subsequent volatilization are variable, and by volatilization without reduction they are high, as might be expected. The last column of Table III may also be used to show how close the calomel tablets put out by good firms check their labelled values. No. 9 illustrates a case where oil is used in compounding the tablets, and the high result by the iodide method indicates a possible absorption of iodine by the oil present.

In conclusion it is important to note that no case has as yet been encountered where the sodium peroxide titration method did not give consistent results, and no trouble was found due to imperfect oxidation. Undoubtedly much of the discrepancy in results is due to the chipped condition in which the tablets were found, in some cases it being difficult to obtain the proper number of unbroken tablets. In several cases the tablets were weighed and the calomel then figured on a percentage basis, thus checking the consistency of the work of the operator. In unbroken tablets a variation of several per cent. in their weights was found, which would explain much of the variation in the last column of Table III. Briggs[7] considers that 15 per cent. variation in weight would not be excessive, which seems, however, to be larger than is necessary.

THE SOUTH DAKOTA FOOD AND DRUG DEPARTMENT, Vermilion.

IS THE PRESENT AN OPPORTUNE TIME FOR THE REVISION OF OUR PATENT LAWS IN SO FAR AS THEY AFFECT MEDICINAL AND CHEMICAL PRODUCTS?

By JOHN K. THUM, Pharmacist at the German Hospital, Philadelphia.

At the October meeting of the Philadelphia Branch of the American Pharmaceutical Association there was more or less discussion as to the advisability of urging upon Congress at this time the need of an equitable revision of our Patent Laws in so far as they relate to medicines and chemicals for the use of the sick.

There is no need at this time to enter into details as to the necessity for such revision. All well-informed pharmacists are aware of

[7] Briggs, *J. Am. Phar. Assoc.*, vol. iii, 33 (1914).

the fact that foreign manufacturers have enjoyed a rich harvest for years, and waxed rich at our expense by taking advantage of these laws which give a patent on a medicinal or chemical product.

Dr. F. E. Stewart, who is chairman of the Committee on Patents and Trade Marks of the American Pharmaceutical Association, and who is recognized as an authority on such matters, was present at this meeting and in the course of the discussion mentioned that the last time he was at Washington advocating legislation along these lines a United States Senator said "that so long as the different organizations and branches of the drug trade came before Congress, each with different ideas and plans, it would be impossible for Congress to do anything. You must get together and agree as to what you want and then we can help you."

If all the different interests of the drug trade in this country were able to get together on the "Harrison Anti-Narcotic Bill," why should they not be able to get together on a matter which has for its object a just and equitable revision of our Patent Law as it affects our calling? Why not put this matter up to the National Drug Trade Conference, and have this body debate the matter thoroughly and formulate some definite plan that will be fair and just to the consumers of medicinal products in this country, to those who are responsible for them and to those various interests of our calling who must handle and distribute them?

Now is the time to push forward this great work. For years and years this question has been under more or less discussion. One could hardly attend a meeting of either a State or National Association without hearing something said about it. Its importance and necessity is conceded by everyone, so why not have the various interests act in concert? Never has American pharmacy had a more favorable and opportune time for the furthering and carrying out of a truly great piece of constructive legislation.

DIGITALIS AND ITS PREPARATIONS.

It is particularly encouraging to those who advocate a more rational study and intelligent administration of drugs, especially in these days when the medical profession is being bombarded on all sides with so-called newer preparations of digitalis, to know that the result of practical research work done by men who have no axes to grind is available to help along such a propaganda.

In a paper entitled "Digitalis and Its Preparations," and which might well be called "The Truth About Digitalis," Dr. Robert A. Hatcher, professor of pharmacology at Cornell University, explodes some conceptions of this drug.

Digitalis, Dr. Hatcher states, acquired a reputation as a household remedy in dropsy some time before it was introduced into medical literature. One of the earliest of writers about this drug was Dr. Withering, an English physician. This physician stated that the wild-grown drug was more active than the cultivated. This belief, Dr. Hatcher says, continues to be still accepted. It is also believed that only the leaves of the second year's growth collected at the time of flowering should be used. This claim is supported by most of the pharmacopœias of the world. How this belief originated no one knows, but it surely was the result of superficial observations, as Worth Hale and other pharmacologists have found, through experiments on animals, that leaves of the first year are more active than the average leaf of the second year. And it is very interesting to know that the leaves used in this work were from cultivated plants.

"Another curious misconception regarding digitalis which is hard to explain is that the leaf grown in certain regions is more active than that grown in other localities. It has often been stated that the Bohemian leaf is too toxic for therapeutic use. Leaves grown in a single locality often show great variations in activity, and it is true that Bohemian digitalis is often very potent. The toxic action of digitalis is simply an extension of the therapeutic action, and it would be as logical to complain of the toxicity of aconite or nux vomica as of that of digitalis.

"At the other extreme is the view that activity and quality must necessarily run parallel. Other things being equal, a drug of a given degree of activity is preferable to one showing but half of the activity; but the case with digitalis is not quite so simple, and it is far more important to have a drug of uniform activity than to have the most active drug that can be obtained. Furthermore, even a uniformly potent digitalis is not necessarily better than a uniform one of less potency, for digitalis contains (or yields) several therapeutic principles, and at least one substance, saponin, which is of minor toxicological importance;—of minor importance because it is present in the leaf only in traces. While all of the therapeutic principles of digitalis exert a more or less qualitatively similar action on the heart, they differ in certain essential side actions, and it does not necessarily

follow that the most active specimen of digitalis contains the largest proportion of the most desirable of these principles. Thus, true digitalin (of Schmiedeberg) is more actively emetic than digitoxin in proportion to its therapeutic activity (contrary to common teaching), and it may be that one specimen which is more active than another may contain the larger proportion of this relatively more active emetic, true digitalin, in which case the less active drug would be decidedly the more valuable.

"We need digitalis which will exert a maximum therapeutic action with a minimum of this undesired action, regardless of whether the drug is from wild or cultivated plants, and whether of the first or second year's growth, and regardless of the actual activity, even within certain limits, for one may administer a larger or smaller dose, provided the activity of the drug be known."

The study of digitalis from this point of view has received little or no attention, and Dr. Hatcher states that it is a field to which the pharmacist could well give some attention. The disagreeable features of this drug is its tendency toward nausea and vomiting, and while, to a certain extent, this is unavoidable, there is a possibility of minimizing it if one can only find out at what season the drug shows a minimum emetic action relative to its therapeutic effect.

While digitalis, like other vegetable drugs, will deteriorate when improperly stored, the extraordinary precautions and requirements of some of the European pharmacopœias are unnecessary; specimens of the whole or powdered leaves examined in the laboratory showed no evidence of deterioration after having been stored in the most ordinary manner in paper boxes, during periods varying from five to twenty-five years.

Speaking on the subject of digitalis from a pharmaceutical standpoint, this investigator emphasizes the necessity of a proper alcoholic content in its liquid preparations. Tinctures and fluidextracts should not only be made with a menstruum of 70 per cent. alcohol, but the finished preparation should actually contain that amount of alcohol; when this requirement is complied with deterioration does not take place in any important degree. Digitalis leaf and the preparations containing this amount of alcohol will retain their potency almost indefinitely without any serious loss if protected from air and sunlight.

Physicians who are inclined to be susceptible to the wiles of the detail man would do well to ponder these words: "Unfortunately,

with the appearance of every proprietary preparation bearing a new label and accompanied by the usual clinical support of its pretensions physicians run after it for a time, believing that the mystery of digitalis has been solved at last. The more observant usually return to the use of a good tincture, or the powdered leaf, when that is obtainable, and the wise pharmacist will stand ever ready to supply a dependable leaf, and a standardized tincture of his own manufacture."

It is generally believed that there is a difference in action between the infusion and tincture of this drug, but such is not the case; the tincture supposedly acting more on the heart and the infusion as a diuretic. Dr. Hatcher shows very clearly that a properly made infusion and tincture contains all of the therapeutically active principles of digitalis. The investigator also says it is easy to demonstrate that the marc left after preparing the tincture is inert by simply preparing an infusion from this marc and testing on a frog. The result is negative.—*The Druggists' Circular,* Sept., 1914, page 517.

J. K. T.

PHILADELPHIA COLLEGE OF PHARMACY.

Semi-annual Meeting.

The semi-annual meeting of the Philadelphia College of Pharmacy was held September 28, 1914, at 4 P.M., in the Library, the President, Howard B. French, presiding. Twenty-one members were present.

The minutes of the quarterly meeting held June 29th were read and approved.

The minutes of the Board of Trustees for the meetings held June 2d and 9th and July 12th were read by the Registrar and approved.

The Committee on nominations presented the list of names for vacancies in the Board of Trustees. The report was ordered entered and filed. The Committee on Membership reported for the year, making suggestions to increase the membership. The President announced the death of the following members since the last meeting: George J. Scattergood, William E. Lee, and Henry C. Eddy.

The President appointed as tellers to conduct the election for Trustees, Dr. Mitchell Bernstein and E. H. Hessler.

While the tellers were counting the ballots Professor Remington reported verbally for the delegates to the American Pharmaceutical Association meeting recently held at Detroit, Michigan. A full report of the meeting by M. I. Wilbert was published in the AMERICAN JOURNAL OF PHARMACY, September number, pages 464 to 471.

The tellers reported the results of the ballot for Trustees, that George M. Beringer, Joseph W. England, and C. Mahlon Kline had been elected for three years, and Samuel C. Henry for one year, whereupon the President declared the gentlemen named as duly elected.

The President appointed the Committee on Membership as follows: Charles H. La Wall, O. W. Osterlund, Richard H. Lackey, with the Treasurer and Secretary *ex-officio*.

Mr. Jacob S. Beetem reported that Mr. Frederick Gutekunst, a graduate of the College, had reached the age of eighty-three years, and he would suggest that the congratulations of the College be tendered Mr. Gutekunst. The suggestion was approved and the President appointed Professor La Wall to prepare a suitable minute, when the following was presented and unanimously adopted: "We, the members of the Philadelphia College of Pharmacy in semi-annual meeting assembled, do hereby extend the congratulations of the College to Mr. Frederick Gutekunst upon having successfully reached his eighty-third birthday. We are proud to feel that the great measure of his success has been partly due at least to the training which he received many years ago in our institution, and we hope that he may be spared to add many more laurels to his wreath of achievements."

It was also voted that the thanks of the College be tendered Mr. Gutekunst for the donation of photographs of some of the present and past officers and faculty of the College.

It was also voted that the thanks of the College be tendered Mr. George B. Evans for the gift of a number of bronze mortars and pestles and several other ornaments of value, collected by him in Europe.

C. A. WEIDEMANN, M.D.,
Recording Secretary.

ABSTRACTS FROM THE MINUTES OF THE BOARD OF TRUSTEES.

June 2nd, 1914.—Sixteen members present. Committee on announcement reported the catalogue number of the Bulletin in press. A sketch of the new certificate was adopted, and the Registrar was directed to place an order at the price agreed upon. Mr. Campbell, for the Special Committee on N. A. R. D. exhibit, reported having arranged for a booth at their Convention, and explained the nature of the exhibit. Mr. George B. Evans kindly agreed to assist in making the exhibit attractive, and also recommended that the exhibit be made.

June 9th, 1914.—Adjourned meeting. Sixteen members present. Committee on Examinations presented the names of those recommended for the degree of Doctor in Pharmacy (P.D.). A teller was appointed and the ballot was then taken and reported clear, and the Chair then declared those named elected to receive the degree of Doctor in Pharmacy. The names of those recommended for the degree of Pharmaceutical Chemist (P.C.) was then read, and, a ballot being taken and reported clear, the Chair declared them elected to receive the degree of Pharmaceutical Chemist. The committee reported that Professors Sadtler and Moerk had recommended that a Certificate of Proficiency in Chemistry be awarded to Harry C. Karns, P.D. The recommendation was approved. The committee also presented a communication from Professor Roddy giving the names of those entitled to receive a Certificate in Bacteriology, and recommended that they be granted. It was so ordered. The committee also presented the name of Paul Donmoyer, Class of 1907, for a Certificate in Bacteriology, as recommended by Professor Kraemer. On motion it was ordered that the certificate be granted and that others who had taken the course under Professor Kraemer and had passed the required examination should be granted certificates and Professor Kraemer be authorized to sign same. The names of those who had won prizes were then read, and the Chair appointed those who were to present same at the Commencement exercises. Committee on Commencement reported that Governor Tener had consented to address the Graduating Class. Mr. Rumsey moved that a vote of thanks be conveyed to those assisting in the Commencement exercises. It was so ordered.

July 22nd, 1914.—A special meeting of the Board was held, in answer to the call of three members, to take action on the death of William E. Lee, a member of the Board. Eleven members were present, and regrets at not being able to be present were received from seven members. Remarks appropriate to the life and character of Mr. Lee were made by Messrs. Boring, Campbell, England, Moerk, Poley, and Weidemann. Mr. Mulford moved that a committee of three be appointed to draft resolutions to be entered on the minutes and an engrossed copy sent to the family. Being so ordered, the Chair appointed Messrs. Mulford, England, and Campbell as the committee. It was suggested that flowers be sent to the house on the day of the funeral. This being considered a special tribute, the members personally paid the expense.

DEPARTMENT OF AGRICULTURE DISCUSSES OBJECTIONABLE LABELLING FOR MEDICINAL PREPARATIONS.

In answer to many inquiries as to proper labelling for medicinal preparations to comply with the Food and Drugs Act as amended, the Department of Agriculture, through the Bureau of Chemistry, has issued the following suggestions to makers and proprietors of medicinal preparations:

1. *Claims of Therapeutic Effects.*—A preparation cannot be properly designated as a specific, cure, remedy, or recommended as infallible, sure, certain, reliable or invaluable, or bear other promises of benefit, unless the product can, as a matter of fact, be depended upon to produce the results claimed for it. Before making any such claim the responsible party should carefully consider whether the proposed representations are strictly in harmony with the facts; in other words, whether the medicine, in the light of its composition, is actually capable of fulfilling the promises made for it. For instance, if the broad representation that the product is a remedy for certain diseases is made, as, for example, by the use of the word "remedy" in the name of the preparation, the article should actually be a remedy for the affections named upon the label under all conditions, irrespective of kind and cause.

2. *Indirect Statements.*—Not only are direct statements and rep-

resentations of a misleading character objectionable, but any suggestion, hint, or insinuation, direct or indirect, or design or device that may tend to convey a misleading impression, should be avoided. This applies, for example, to such statements as "has been widely recommended for," followed by unwarranted therapeutic claims.

3. *Indefinite and Sweeping Terms.*—Representations that are unwarranted on account of indefiniteness of a general sweeping character should be avoided. For example, the statement that a preparation is "for kidney troubles" conveys the impression that the product is useful in the treatment of kidney affections generally. Such a representation is misleading and deceptive unless the medicine in question is actually useful in all of these affections. For this reason it is usually best to avoid terms covering a number of ailments, such as "skin diseases, kidney, liver, and bladder affections," etc. Rheumatism, dyspepsia, eczema, and the names of many other affections are more or less comprehensive, and their use under some circumstances would be objectionable. For example, a medicine should not be recommended for rheumatism unless it is capable of fulfilling the claims and representations made for it in all kinds of rheumatism. To represent that a medicine is useful for rheumatism, when as a matter of fact it is useful in only one form of rheumatism, would be misleading, such statements as "for some diseases of the kidney and liver," "for many forms of rheumatism," are objectionable, on account of indefiniteness.

Names like "heart remedy," "kidney pills," "blood purifier," "nerve tonic," "bone liniment," "lung balm," and other terms involving the names of parts of the body are objectionable for similar reasons.

4. *Testimonials.*—Testimonials, aside from the personal aspect given them by their letter form, hold out a general representation to the public for which the party doing the labelling is held to be responsible. The fact that a testimonial is genuine and honestly represents the opinion of the person writing it does not justify its use if it creates a misleading impression with regard to the results which the medicine will produce.

No statement relative to the therapeutic effects of medicinal products should be made in the form of a "testimonial" which would be regarded as unwarranted if made as a direct statement of the manufacturer.

5. *Refund Guarantee.*—Statements on the labels of drugs guaranteeing them to cure certain diseases or money refunded may be so worded as to be false and fraudulent and to constitute misbranding. Misrepresentations of this kind are not justified by the fact that the purchase price of the article is actually refunded as promised.

WASHINGTON, D. C.

GINSENG GROWERS MAY FIND GOLDENSEAL AN ADMIRABLE SIDE CROP.

HOWEVER, MARKET FOR THIS NATIVE DRUG PLANT IS LIMITED, LABOR COSTS ARE HIGH, AND SPECIAL CARE IN CULTIVATION IS NECESSARY.

Goldenseal is a native drug plant of admitted commercial value, which is rapidly becoming scarce, and farmers who have had experience with ginseng may find in goldenseal an admirable side or succession crop. This is the opinion of one of the U. S. Department of Agriculture's drug-plant specialists, whose pamphlet, "Goldenseal Under Cultivation," has just been issued as Farmers' Bulletin 613. Goldenseal, known to the pharmacist and physician as hydrastis, is native to open woodland where there is ample shade, good natural drainage, and an abundance of leaf mold. It is most abundantly found in Ohio, Indiana, West Virginia, and Kentucky, though it grows west to Minnesota, south to Georgia, and in southern New York. It is not grown in Europe on a commercial scale, and the United States exports quantities of this drug to Germany.

In general, drug plants are difficult to grow, labor costs are high, and the market is limited. These drawbacks are true to goldenseal but ginseng growers who are already equipped for the culture of exacting woodland plants, but whose ginseng crops have been attacked by pests and diseases, should meet with some success with goldenseal. The latter requires essentially the same conditions as the other crop, but is easier to grow, being far less subject to disease and attacks from mice.

STEADY ADVANCE IN MARKET PRICE.

There began to be a commercial demand for goldenseal about 1860, and since then its use has become world-wide, although most of it is consumed in this country. It is valued solely for its remedial

properties, and was commonly used by Indians and early settlers as a remedy for sore mouth and inflamed eyes; also as a bitter tonic in stomach and liver troubles.

Until about the year 1880 the prices paid for crude goldenseal rarely ranged over 8 to 12 cents a pound, these prices, as a matter of course, being based on the actual cost of collecting and curing the material where it was abundant. In 1890, however, the approaching scarcity of the root was manifested by rising prices, and at the close of the next decade the cost had advanced to an average of 58 cents a pound. Early in 1904 the price passed the dollar mark, the year closing with wholesale quotations varying from $1.35 to $1.50.

With the exception of slight fluctuations in 1912, which were apparently the result of overcollection, there has been a steady advance in the price of the dried root, both wild and cultivated. The prices paid to growers and collectors of goldenseal for the last three years have ranged from $3 to $4.25 a pound, and these prices are thought to be a fair basis of profit in goldenseal culture, even after taking into consideration the rather exacting requirements of the plant and its relatively slow progress toward commercial maturity.

Not an Easy Crop to Grow.

It costs about $1500 an acre, exclusive of the value of the land, to start a goldenseal plantation. This includes the average cost for propagating material, but makes no provision for irrigation during dry weather. Of course, special conditions, such as local cost of labor, lumber, and fertilizers, will influence this estimate. This outlay might well discourage those who wish to cultivate the plant on a large scale, but small home and experimental plantings may usually be started at a very small cost. In any case the plan requires special care and suitable conditions at all stages of its development.

Goldenseal takes considerable time to develop. If it is grown from seed under favorable conditions it only reaches its best development for market after about five years. If it is grown from root buds or by division of the rootstock, it reaches its best development in three or four years. Successful growers have outputs of about 2000 pounds of dried root per acre after five years from seed. Better showings might be made by well-equipped small growers.

A market for goldenseal is found with the crude drug dealers and manufacturing druggists in most large cities. This root is also handled on commission and is readily purchased by fur buyers and traders in miscellaneous forest products. The estimated annual consumption, however, is only 100 tons, and as only about 500 acres would be needed to produce that amount, overproduction would be easy. Prospective planters must bear this in mind, as well as the fact that this estimate makes no allowance for the wild supply of the root, which is still a factor, although rapidly decreasing.

Ginseng growers will be interested in the new bulletin on goldenseal. It goes into great detail regarding methods of cultivation, and may be had free on application to the Division of Publications, U. S. Department of Agriculture, Washington, D. C.

THE POISONOUS NATURE OF THE STINGING HAIRS OF JATROPHA URENS[1]

Jatropha urens is one of the most abundant Euphorbiaceous plants growing in or around the savannas of the Pacific coast of Central America. Its spread is favored by the fact that the cattle avoid it, and because it is not kept down by the too indolent owners of the pastures. Everywhere it has the reputation of being extremely dangerous, on account of its poisonous effects.

The plant is easily recognized: It is herbaceous, 0.5 to 1.5 meter high, regularly ramified, with large, palmatilobate leaves, white flowers and small, 3-celled capsules. All parts, trunk, leaves, flowers and fruits are covered with long, hard and glossy, stinging hairs, which protect the plant as barbed wire protects the fortifications of to-day. It would seem as if the remarkable glossiness of the stinging hairs might warn the curious against approaching or touching. As a matter of fact, the animals, either by instinct or on account of the wisdom acquired through some previous experience, avoid contact with it.

The vernacular name of *Jatropha urens* is "ortiga" or "ortiga brava" (nettle) in Panama, and other parts of Central America, indicating somewhat its noxious effects. Sometimes it is also called "chichicaste."

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[1] *Science*, October 23, 1914, p. 609.

The stinging hairs of *Jatropha urens* show the same structure as those of the common nettle (Urticaceæ), though the two plants belong to different families. The poison is produced by a cell of the epidermis which, during the growth, swells up, forming a goblet-shaped bulb, set into the surrounding tissue. The hair then represents a long tube, the walls of which have incrustations of silicic acid in the upper part and are calcified in the lower parts, so that they are very brittle and break at the lightest touch. Near the top this cell expands a little, in the form of a miniature hat with very thin walls, so that when touched, it breaks in an oblique direction, forming the point of a cannula, which enters the skin of animal or man. At the same time the poisonous liquid of the cell is discharged into the wound, and produces instantly a local inflammation. The mechanism is, in fact, the same as that of the poison fang of the snakes, and it is also similar to the cannula of the surgeon.

To estimate the formidable effects of the hair and the intensity of its poisonous liquids, it has been calculated that about 10,000 hairs of the common nettle may produce one drop of poison (0.05 c.cm.). As in the case I am going to mention, about 10 hairs of the *Jatropha* were broken. It may be calculated on the same basis that about 0.00005 c.cm. of poison entered the wound. This is, however, a low estimate, because the hairs of our plant and their inner cavity are larger than those of the common nettle and the amount of poison introduced into the system in the following occurrence was probably much larger than it would have been in the case of an equal contact with *Urtica urens*.

On an excursion along the San Felix River, in eastern Chiriqui, with Dr. MacDonald, geologist of the Canal Commission, the writer became acquainted with *Jatropha urens* by unavoidable contact with a single specimen of the plant. All at once he felt an intense burning on the left hand, where about 10 of the stinging hairs had entered pretty deep into the skin. The inflammation produced by this touch was very similar to that produced by nettles, but the pain soon increased, the whole hand began to swell and inside of half an hour had assumed a monstrous shape. Then the arm commenced to swell also, the right hand and arm, without having been inoculated, yet showed the same abnormal symptoms, and a very strong itching sensation was felt all over the upper part of the body. At about the same time parts of the face, around the eyes and nose, swelled

considerably. The itching sensation rapidly spread over the abdomen and the lower extremities and red pimples appeared everywhere. In less than an hour the poison had extended over the whole surface of the body, and its entrance into the blood current was indicated by the corresponding physiological reaction of the interior organs. The palpitation of the heart became extremely accelerated and the mind was soon overcome by an agonizing depression. The respiration seemed to be delayed as if under a great pressure, cold sweat broke out, and the patient gave way altogether, remaining unconscious for more than an hour, except for feverish dreams. After coming back to his senses, he had several fits of copious vomiting, from which it may be surmised that the poison was slowly eliminated from the organism. The weakness, however, remained for several days.

A case of such extreme effects, which might have killed a man of less strength than the writer, has never been recorded, as far as the literature on the subject shows. Undoubtedly the intensity of the intoxication was due to the rather strong contact with the plant, which caused a considerable amount of poison to be introduced into the blood circulation.

Many other tropical plants, among them some *Urticaceæ* and *Loasaceæ*, have such deadly stinging hairs, the poison of which is active enough to kill a man, even in a relatively small dose. The only way of allaying its effects would be to neutralize or precipitate it by means of a prompt application of chloride of lime, ammonia or sodium permanganate.

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UNITED STATES CHAMBER OF COMMERCE TO STUDY FOOD AND DRUG QUESTIONS

The Chamber of Commerce of the United States of America, a body composed of representatives from about 600 local boards of trade, chambers of commerce, and trade associations, widely distributed throughout the United States, has taken up the study of the subject of uniform food and drug regulation. For this purpose a special committee was appointed in July, and its first meeting was

held at the headquarters of the Chamber in Washington, October 8th. The committee is composed of Willoughby M. McCormick, of Baltimore; A. J. Porter, of Niagara Falls; John A. Green, of Cleveland; B. L. Murray, of New York, and Theodore F. Whitmarsh, of New York. Mr. McCormick, the chairman, is a member of the Board of Directors of the Chamber of Commerce of the United States, and the head of the firm of McCormick & Co., manufacturers of extracts and drugs and importers of spices and teas; Mr. Porter is president of the Shredded Wheat Company; Mr. Green is secretary of the National Association of Retail Grocers; Mr. Murray is chemist to Merck & Co.; and Mr. Whitmarsh is vice-president of Francis H. Leggitt & Co.

The position taken by the committee on the meaning of uniformity is interesting and will repay close examination. Its views are not confined to a limited horizon but are intended to grasp the broader and wider fields. Its efforts will be confined to no organization or class of people. It hopes to cover in its endeavors the position of the wholesaler, the retailer, the consumer, the manufacturer, the official, and all others concerned in the production, handling and consumption of food and drugs. But only the broad, general questions of national character will be considered. After a lengthy discussion the committee at its meeting, by unanimous vote of all present, adopted the following regarding uniformity:

> Uniformity, as the committee would define it, involves the highest degree of efficiency in food and drug control which it is possible to have prevail universally and equally in every part of the nation. The Federal, State, and municipal laws and their regulations would, if perfect uniformity were attainable, reach the level of full and complete efficiency, and thereby afford equal protection and a uniform standard of living for all the people. Uniformity accomplished, places merit and the general public interest over local political or geographical divisions. This committee will, therefore, direct its efforts and consideration toward the accomplishment of uniformity. The committee cannot but feel impressed with the magnitude, the importance, and the seriousness of its work. It cannot but feel the need for the closest study of the subject. And, again, the committee cannot but feel the necessity for the fullest and most cordial coöperation between itself and the officials and all others concerned. The committee will, of necessity, act deliberately and slowly, making certain of each step, considering only the important problems of a national character.